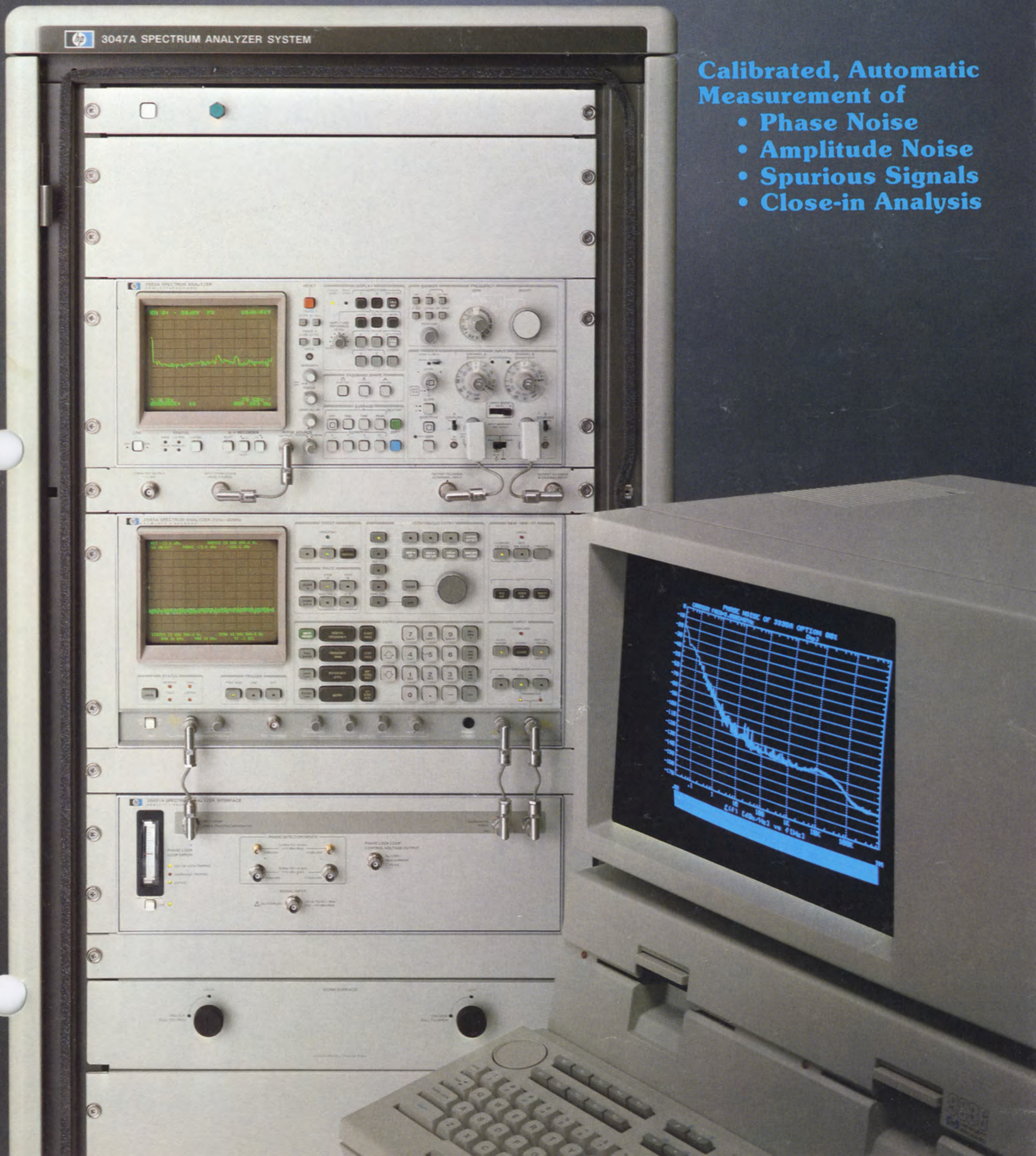
HEWLETT PACKARD

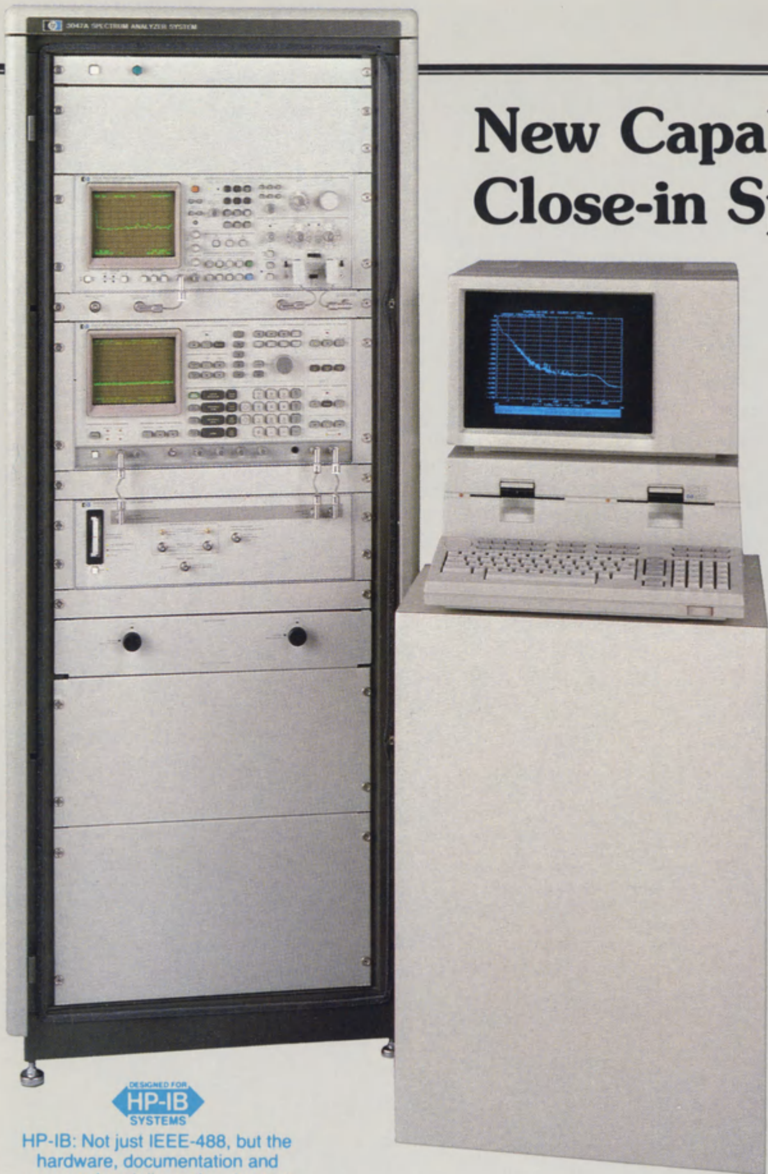
Spectrum Analyzer System 3047A

Technical Data January 1983

Calibrated, Automatic Measurement of
- **Phase Noise**
- **Amplitude Noise**
- **Spurious Signals**
- **Close-in Analysis**



New Capabilities in Close-in Spectrum Analysis

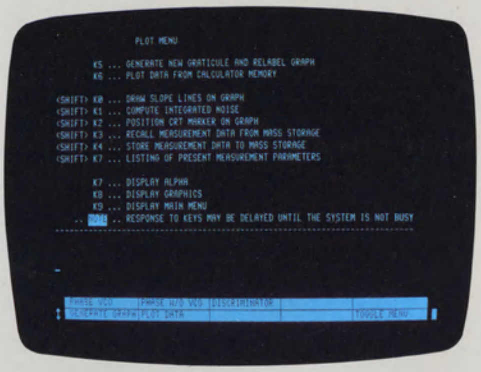


HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

The HP 3047A Spectrum Analyzer System combines the speed and millihertz resolution of Fast Fourier Transform (FFT) Spectrum Analysis with the frequency range of Swept Spectrum Analysis. This unique measurement combination is joined with the powerful computational and control capabilities of a desktop computer to give a wide variety of calibrated spectrum analyzer measurements.

Complete Signal Processing capabilities needed to make close-in spectrum analysis measurements are built into the system including phase detectors, low-noise amplifiers, filters, and analyzers. External phase detectors and filters needed for higher frequency carriers can also be used.

Programming Experience Is Not Required to use the system. Simply insert the software media, turn on the computer power and the program will be automatically loaded and run. Then answer a few questions about the test setup and follow the instructions given by the computer for connecting the device under test. The tests are then automatically run and the results plotted on the specified output device with the speed, accuracy and repeatability of computer-controlled testing.



Results Can Be Plotted on the computer display or saved in hard copy form. Or, if desired, a Hewlett-Packard Graphics Language (HP-GL) plotter such as the HP 9872 or 7470A can be used with the system. The measurement results and all measurement parameters can be stored on the controller's internal mass storage device, or on an optionally available external flexible disc memory such as the HP 9885M or 9895A.

Graphs Can Be Edited without repeating the measurement because all the data is stored in the desktop computer memory. For instance, if some of the data is off the scale of the graph, the scale can be changed and the data replotted without rerunning the measurement.

The 3047A Spectrum Analyzer System

Phase Noise Mode

The Ultimate Performance in Phase Noise Measurements

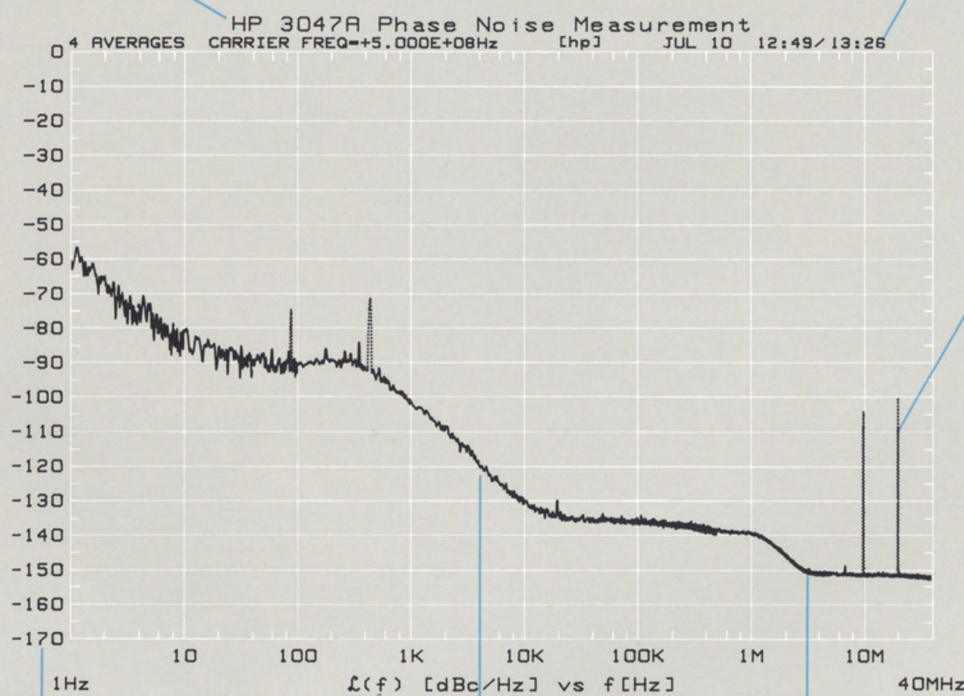
Measure 0.02 Hz to 40 MHz away from
5 MHz to 18 GHz Carriers
including measurements on:

- **Oscillators**
- **Frequency Standards**
- **Amplifiers**
- **Frequency Multipliers & Dividers**

User Annotation of Up to 58 Characters

Dated Plots With Measurement Start/Stop Time

Single Sideband Phase Noise



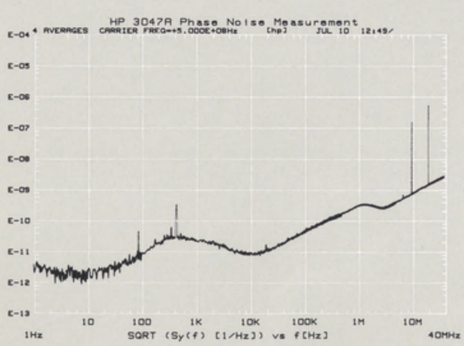
Discrete Signals Displayed in dBc to 2 dB Accuracy

170 dBc/Hz Noise Floor

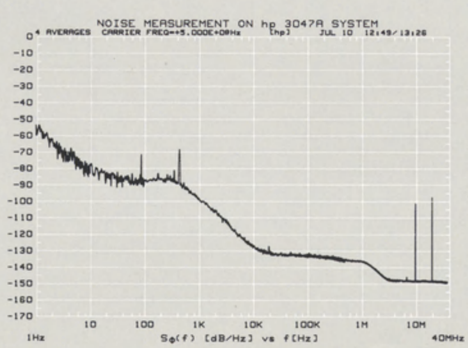
Noise Measurement Normalized to 1 Hz Bandwidth

Continuous Plots—No Frequencies Missed!

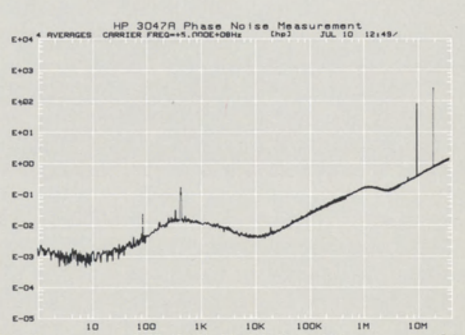
Or, if you prefer, measurements can be presented as S_y, S_ϕ or S_ν



S_y



S_ϕ



S_ν

Provides Three Measurement Mode
for Complete Answers to Your Freq

Direct Spectrum Mode

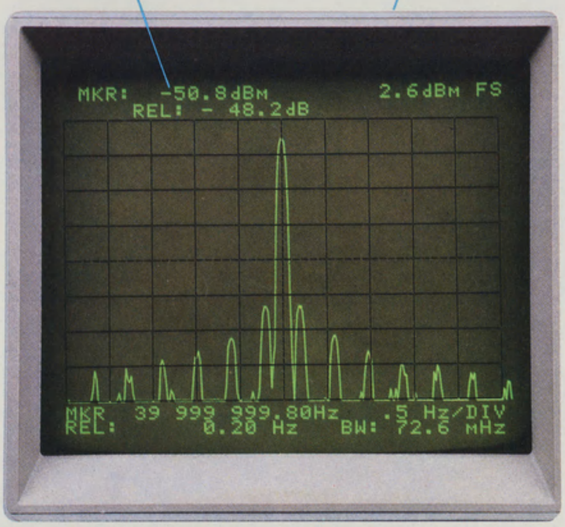
0.02 Hz Resolution to 40 MHz with FFT Analysis Speed

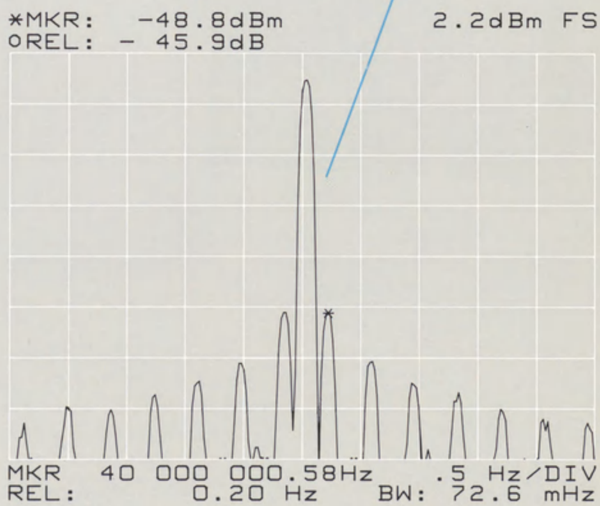
In the Direct Spectrum Mode the system hardware is used as a down converter to bring 19 kHz to 40 MHz signals into the frequency range of the 3582A Real Time Spectrum Analyzer. This allows the very high resolution and measurement speed of the Real Time Spectrum Analyzer to be used up to 40 MHz. In this mode the system is capable of resolution bandwidths as narrow as 0.02 Hz and is one to two orders of magnitude faster than a swept spectrum analyzer. The system provides these measurements over the wide dynamic range of 70 dB, calibrated in both frequency and amplitude.

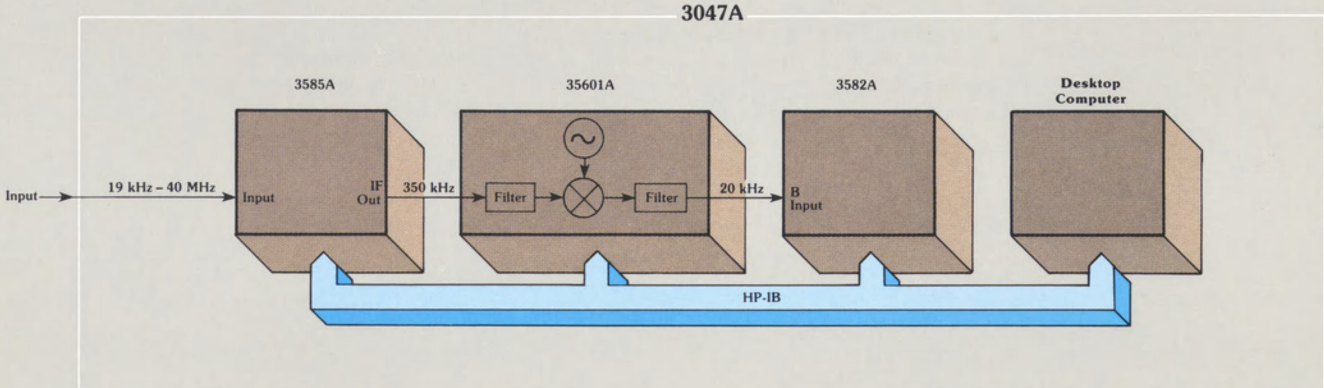
Calibrated Results, Accurate to ±0.9 dB

Make Measurements With the Analyzer Display . . . or Save as Printed or Plotted Copy.

70 dB Dynamic Range







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uency Stability Analysis Problems.

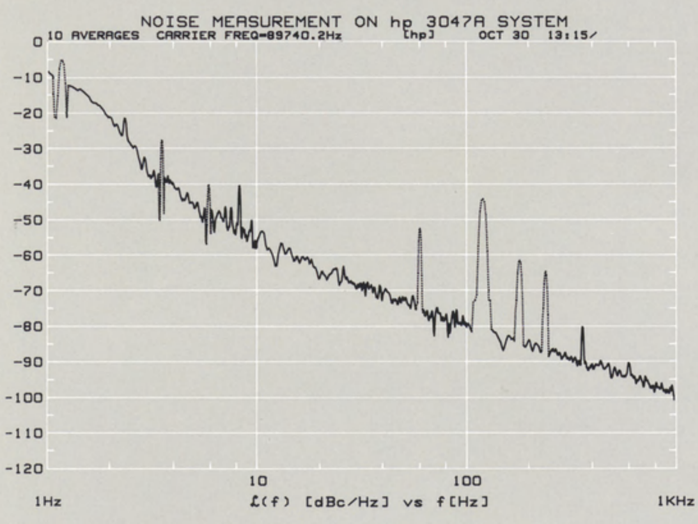
Noise Sideband Mode

Amplitude and Phase Noise Measurements from 0.02 Hz to 25 kHz away from Carriers 20 Hz to 40 MHz

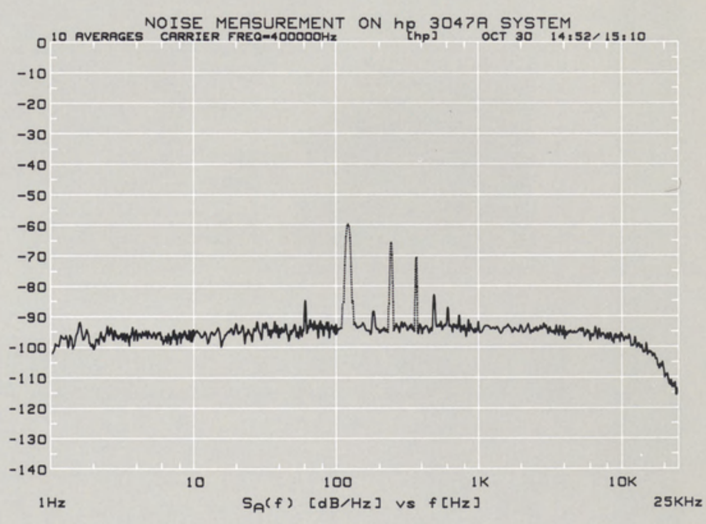
While the 3047A can measure very high quality sources in the Phase Noise Mode, moderate performance sources can be measured more easily in the Noise Sideband Mode. In this mode the system measures both AM and PM noise without additional hardware. The system software connects the 3047A input to the 3585A and the output of the analyzer is fed into an internal phase detector. The output of the detector is connected to the 3582A Analyzer and the phase noise measured over the .02 Hz to 25 kHz range. In addition, a second detector is provided which outputs the AM noise of the signal to the second channel of the 3582A Analyzer.

Sources with noise greater than the 3585A Spectrum Analyzer's local oscillators are very easy to measure with the 3047A in this mode. The source under test is just connected to the 3047A and the measurement is run. There is no need for a high quality reference or for a frequency discriminator.

Phase Noise



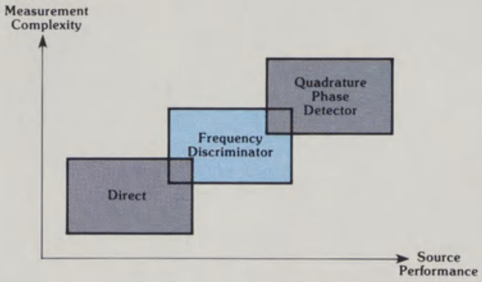
Amplitude Noise



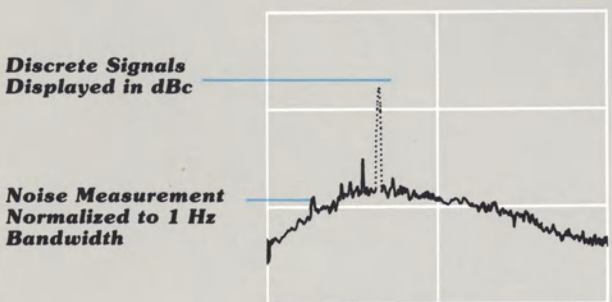
Phase Noise Operating Mode

Phase Noise Measurements

When used with the 3047A, the term phase noise includes all forms of frequency and phase instabilities. Frequency and phase noise as well as undesired modulation like power-line phase modulation and phase jitter are included in the term and can be measured by the 3047A Spectrum Analyzer System.



The complexity of phase noise measurements increases with increasing source performance. For relatively noisy sources, the noise can be measured directly on an existing spectrum analyzer. However, for many sources this measurement is not sensitive enough. If the spectrum analyzer is proceeded by a frequency discriminator or phase detector, the system sensitivity can be increased at the cost of additional measurement hardware. The Phase Noise Measurement Mode of the 3047A is designed to reduce the difficulty of making accurate phase noise measurements with either the frequency discriminator or quadrature phase detector techniques.

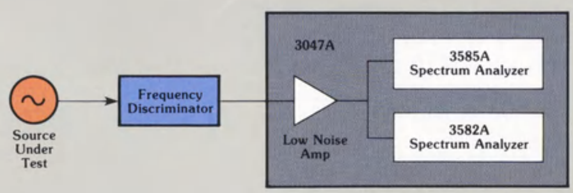


No matter which of the above techniques are used, phase noise measurements are always made with respect to a 1 Hertz bandwidth. To measure the entire spectrum in a 1 Hertz bandwidth would take an excessive amount of time so, as is common practice, the 3047A measures the phase noise in wider bandwidths as the frequencies are further removed from the carrier. (Close to the carrier, bandwidths much less than 1 Hertz must be used.) From these measurements, the system normalizes the noise to a 1 Hertz bandwidth and plots this result. However, if a discrete tone is measured (coherent phase modulation or a "bright line"), then the measurement should not be corrected for the measurement bandwidth as the level of the tone is independent of the measurement bandwidth. The 3047A detects the presence of discrete signals in the spectrum and does not normalize their amplitude, plotting these signals with a dotted line to show this fact.

This is just one example of the system software detecting and correcting possible measurement errors. The desktop computer monitors all measurements to detect conditions that would effect the accuracy of the results. For instance, in the phase quadrature measurement mode the software can detect if the two sources have injection locked or if the phase-lock loop comes out of lock. Either of these conditions invalidates any measurement so the measurement is stopped and the software gives an error message to the operator. Under other possible error conditions the measurement may be valid, but with reduced accuracy. In these cases the software stops the program, warning the operator about the reduced accuracy but allows him to continue the test if desired.

Frequency Discriminator Method

Phase noise measurements with a frequency discriminator are the easiest to understand. Any variations in the carrier frequency or phase are changed into voltage variations by the discriminator. These voltage variations are then analyzed by the 3047A System. The system software can present the measurement as frequency ($S_\nu(f)$ or $S_y(f)$) or phase noise ($S_\phi(f)$ or $\mathcal{L}(f)$). However, frequency discriminators with adequate sensitivity to measure state-of-the-art sources are inherently narrow band devices. Since the system covers the extremely wide frequency range of 5 MHz to 18 GHz, it is not feasible to include a frequency discriminator or even a set of discriminators in the system to measure sources over this entire range. Instead, the capability of making calibrated measurements with a customer supplied frequency discriminator is included in the 3047A System. To calibrate the system, the user can provide a known level of phase modulation or add in a signal of known level and the 3047A software will properly calibrate the system to give results accurate to ±2 dB.

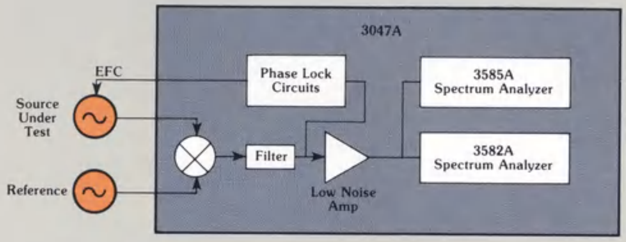


Phase Detector Method

As mentioned above, phase noise can also be measured with a phase detector. A common way to make a low noise phase detector is to use a double balanced mixer. If two signals of the same frequency and 90° out of phase are applied to the mixer, the output will contain a low frequency signal whose amplitude represents the phase noise of the sources. This signal can be amplified and analyzed by a low frequency spectrum analyzer to give the noise as a function of frequency away from the carrier frequency. As in the frequency discriminator measurements, the system software can present this phase noise measurement as phase noise ($\mathcal{L}(f)$ or $S_\phi(f)$ or frequency noise ($S_\nu(f)$ or $S_\nu(f)$).

This quadrature phase detector method has the advantage of using an inherently wideband mixer as the phase detector. Therefore, only the two detectors provided are needed to cover the 5MHz to 18 GHz frequency range of the 3047A and this frequency range can be easily extended either higher or lower in frequency by adding appropriate mixers and filters. For instance, millimeter wave sources could be measured using a mixer mounted in a waveguide as the phase detector. Because the system software can measure the sensitivity of this external detector, the measurement results are fully calibrated.

Another advantage of the quadrature phase detector method is that it inherently rejects AM noise, whereas most frequency discriminator circuits do not. AM noise is usually less than the phase noise, but in cases where this is not true, this is an important advantage.



Phase Detector Method

This phase detector system depends on the 90° phase relation between two sources. Unless the sources are extremely stable, they will not stay 90° out of phase for any length of time. A solution to this problem is to lock one of the sources to the other with a phase-lock loop. The loop provides a tuning voltage to one of the sources to maintain the two sources at the same frequency and, on the average, 90° out of phase. For frequencies relatively far from the carrier, the phase-lock loop does not affect the signal to the analyzer. For lower frequencies, the phase-lock loop causes the controlled source to follow the phase variations of the other source. This causes the voltage to the analyzer to represent the frequency noise at low frequencies and phase noise at higher frequencies.

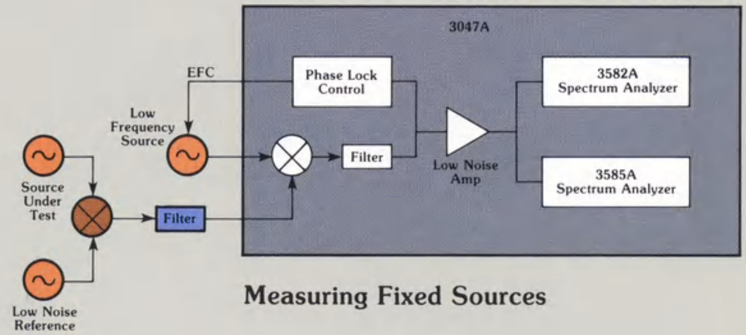
To avoid this difficulty, previous techniques restricted the loop bandwidth to much less than the lowest frequency to be measured. These techniques work well with very quiet sources like crystal oscillators, but a narrow bandwidth loop cannot track the variations in a noisy source. Therefore, these techniques have not previously been used to measure phase noise close to noisy signals.

The 3047A's unique approach solves this tradeoff by adding the computing power of a Desktop Computer. The system software measures the transfer function of the phase-lock loop before the phase noise measurement and uses this information to correct for the effects of the phase-lock loop on the voltage to the analyzer. This means that the loop bandwidth can now be chosen to be wide enough to keep a noisy source in lock and yet measurements can still be made as close as .02 Hz from the carrier.

Since the phase noise measured by the quadrature phase detector method is the sum of the noise of the reference and the source-under-test, it requires that the reference source be of at least equal phase noise performance to the source-under-test. This can be done when measuring sources with good phase noise performance by adding a high quality frequency synthesizer like the HP 8662A to the system as a reference. Its large frequency range is ideal for testing a wide variety of sources. However, if the test calls for measuring a truly state-of-the-art source, no frequency synthesizer will have sufficient performance. Then the only way to make the measurement is to use a second source, identical to the source-under-test as a reference. Since a frequency discriminator does not have sufficient sensitivity to make this measurement, this is often the only way to measure very low phase noise sources. When attempting to improve low noise source designs, the 3047A offers the three source comparison software (described in the next section.) which separates out the noise contribution of each source.

An additional requirement of the quadrature phase detector method is that one of the sources must have electronic frequency control. Many sources are designed with this capability or it can be easily added. In the few cases where this is not practical, a third tunable source can be added to the system to complete the phase-lock loop as shown in the figure below.

One such case occurs when measuring frequencies in the gigahertz region where low phase noise sources are often only available at fixed frequencies (e.g., a low noise multiplied crystal oscillator). If such a low noise source is mixed with the source-under-test, a low frequency signal is generated. This signal can then be measured by the 3047A against a tunable low frequency reference.



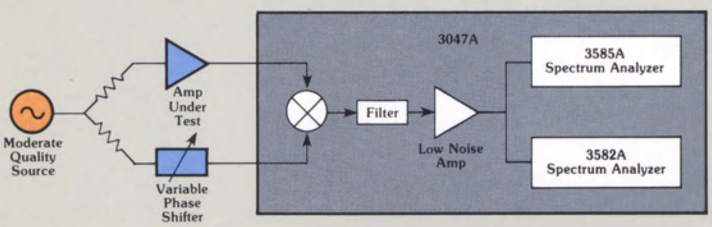
Measuring Fixed Sources

Measuring Other Devices

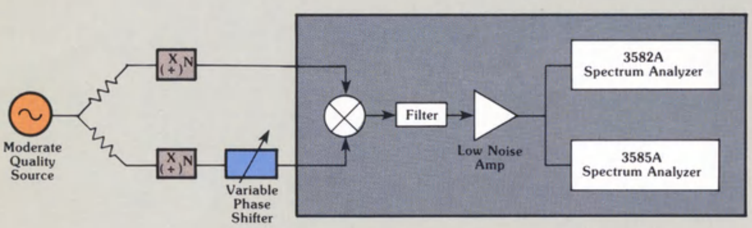
In addition to measuring LC, YIG, Crystal, SAW, and other sources as shown above, the 3047A Spectrum Analyzer System can be used to measure the phase noise of frequency standards, amplifiers, frequency dividers and multipliers.

Measuring Amplifiers, Frequency Dividers and Multipliers

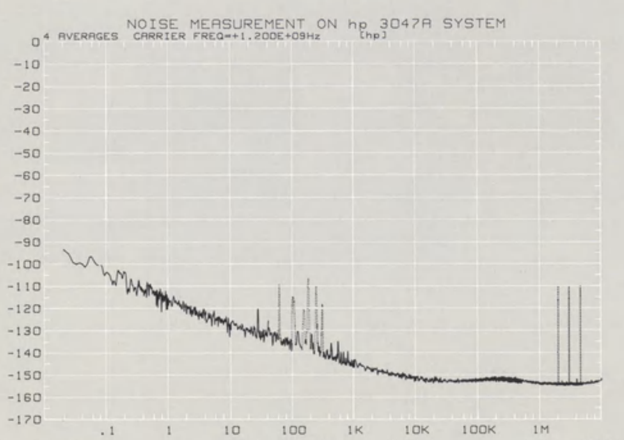
The phase noise performance of amplifiers, frequency multipliers and dividers used can often limit system performance. The 3047A can easily measure these components with the addition of a source at the desired stimulus frequency. Only a moderate quality source is needed since its phase noise is applied to both 3047A inputs and is canceled.



Measuring Amplifier Noise



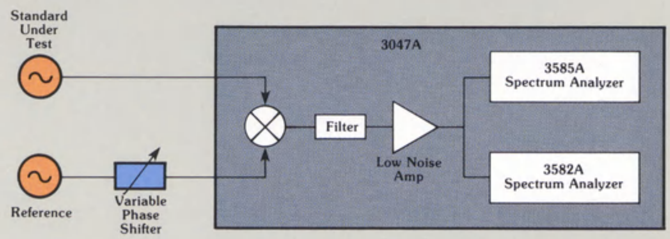
Measuring Multiplier or Divider Noise



Amplifier Phase Noise

Measuring Frequency Standards

Because two frequency standards will be at the same frequency, there is no need to complete the phase-lock loop used above with other sources. To insure that the two standards are 90° apart, a phase shifter should be added and adjusted until the meter on the 3047A reads zero. Because of the inherent stability of the frequency standards, phase quadrature can be maintained throughout the measurement.



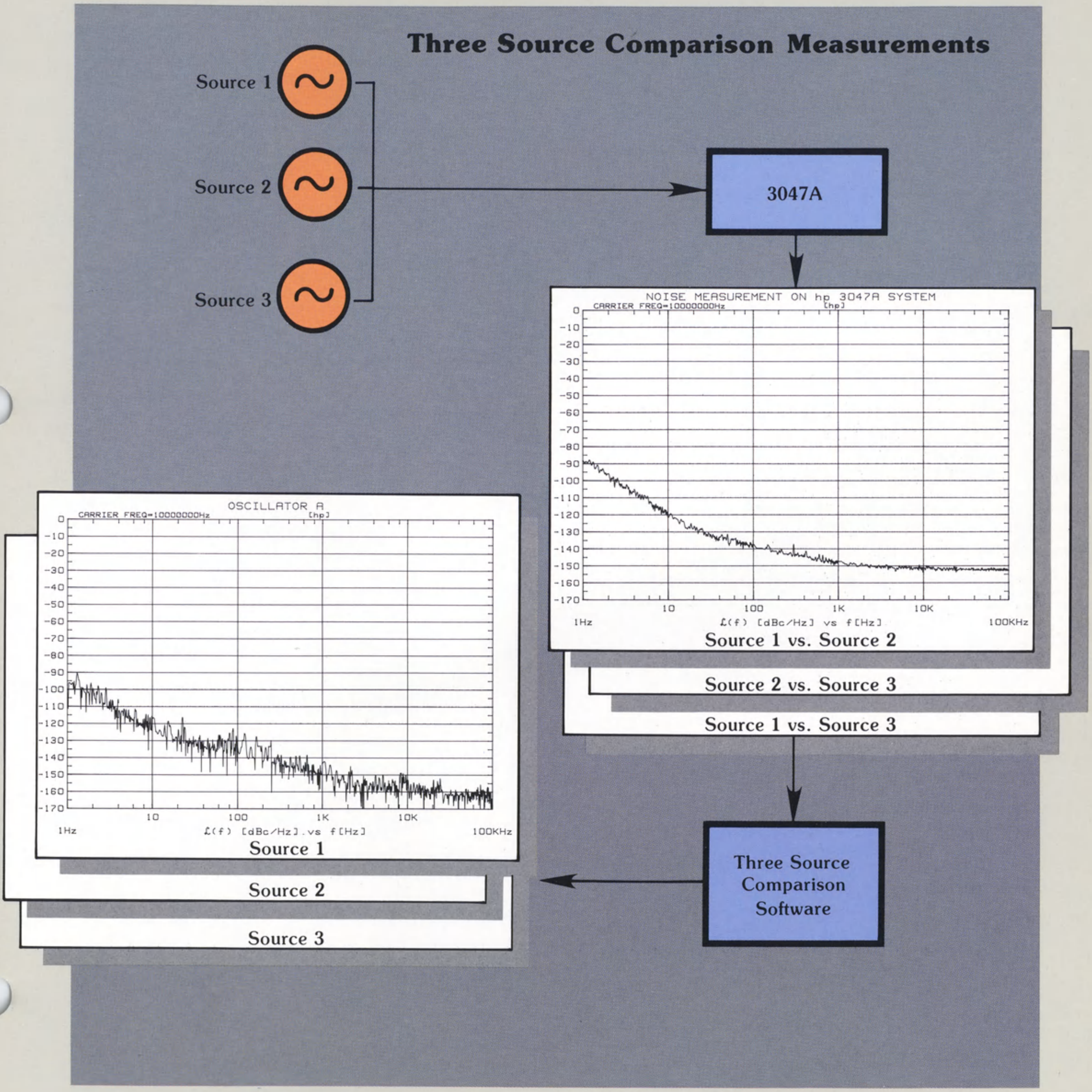
Measuring Frequency Standards

As in measuring oscillators, the phase noise plot will be the sum of the noise of both standards. If the reference frequency standard's phase noise is not known, then its effects cannot be removed in a single measurement. However, if a third frequency standard is available, the phase noise of each standard can be determined using the 3 oscillator comparison software described next.

Three Source Comparison Measurements

To make phase noise measurements on state-of-the-art sources, you must normally compare two sources in phase quadrature. (Generally, the frequency discriminator method will not yield an adequate noise floor due to the limited sensitivity of the discriminator.) However, when two sources are compared, the resulting noise measurement is the sum of the noise of both sources. Two assumptions have been made in the past to deal with this problem. First, if the noise of the reference source is known, it can be subtracted from the measurement. Second, if the sources are nominally identical, 3 dB is subtracted from the curve under the assumption that the noise contributions are equal. This is often not the case when the noise source is device dependent, e.g., flicker noise in transistors or quartz crystal resonators.

There is, however, a third alternative which has been implemented in the 3047A System. If three sources are compared pair-wise in three separate measurements, the absolute noise level of each source can be determined by solving three simultaneous linear equations at each measurment frequency. While this would be a tedious calculation if done by the operator, the powerful computational capability of the 3047A's Desktop Computer easily makes this calculation at all the measurement frequencies of the system.



System Library

The 3047A System Library consists of all operation and service manuals for the instruments in the system as well as all the manuals for the Desktop Computer.

In addition, the following system reference materials are included: an installation manual, which contains all necessary information for system installation and checkout, an operating manual, to aid in setting up and running the actual measurements, and a two volume reference guide, which includes software flowcharts and gives suggestions on how to change the test configuration to avoid errors detected by the system.

System Installation and Training

To help you quickly get good measurements, system installation and training at your site are included with the 3047A system. A trained HP customer engineer will come to your site, install the system and verify that it is operating correctly. In addition, an HP System Engineer will come to your site and give a one day course on how to make measurements with the system.

System Warranty *

A complete warranty program covers the HP 3047A system hardware for 90 days (U.S. and Canada) following the system installation date. During this period, HP will diagnose system failures at your site and provide appropriate repairs. (Controller repairs will normally be completed on site; instruments may require return to an HP service center).

*Outside the U.S. and Canada, the warranty for the HP 3047A is determined by local HP policy. Contact your local HP Sales and Service Office for more information.

Specifications

Phase Noise Measurement Mode

Phase Detector Inputs

Frequency

Carrier Frequency Range: 5 MHz to 18 GHz in two ranges

	Frequency Range	Return Loss	Isolation
Low Frequency Inputs:	5 MHz to 1.6 GHz	5 dB (3.5 VSWR)	15 dB
High Frequency Inputs: (may be deleted with Option 110)	1.2 GHz to 18 GHz	5 dB (3.5 VSWR)	15 dB

(The frequency range can be extended with customer supplied mixer or frequency discriminator)

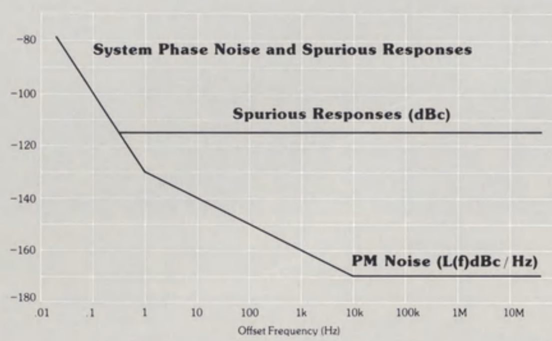
Offset Frequency Range:

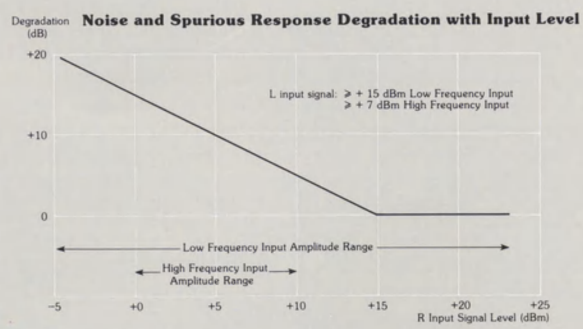
.02 Hz to 40 MHz for carriers from 95 MHz to 18 GHz

.02 Hz to 1 MHz for carriers from 5 MHz to 95 MHz

Amplitude

	5 MHz −1.6 GHz		1.2 GHz −18 GHz	
	L input	R input	L input	R input
Maximum Signal Level (dBm)	+23	+23	+10	+10
Minimum Signal	+15	−5	+7	+0





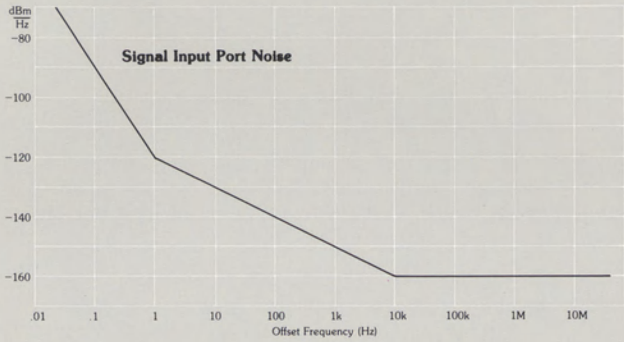
To determine system noise and spurious response levels, find the dB degradation at the signal input level from the lower graph and add to upper curves. For example, if a +15 dBm signal is applied to the Low Frequency L Input and a +5 dBm signal to the R Input, the degradation is +10. Therefore, the system spurious signals are -105 dBc at all offset frequencies and the system noise curve is raised 10 dB, giving a noise floor at large offset frequencies of -160 dBc/Hz.

Accuracy:

.02 Hz – 1 MHz	1 MHz – 40 MHz
± 2 dB	± 4 dB

Signal Input Port (for use with external phase detector or frequency discriminator)

Frequency Range: 0.02 Hz to 40.1 MHz
Input Impedance: 50Ω, Return Loss 9.5 dB (2:1 VSWR)
Max Amplitude: 1 Volt peak
Spurious Responses: < − 100 dBm



Accuracy: External phase detector measurements or frequency discriminator measurements calibrated with ± 1 dB accurate signals

.02 Hz – 1 MHz	1 MHz – 40 MHz
± 2 dB	± 4 dB

Control Voltage Output

Voltage Range: ± 10V
Current: ± 20 mA max
Impedance: 50Ω

Measurement Restrictions

In addition to the above stated limitations on the amplitude and frequency of the sources which can be measured in this mode, the following restrictions also apply.

Source Return Loss: 9.5 dB (2:1 VSWR)
Source Harmonic Distortion: < − 30 dB (or the source may output a square wave.)

If either of these conditions are violated, the accuracy of the system measurement will be reduced.

Also, the tuning range of the source which is controlled by the phase-lock loop must be commensurate with the noise level of both sources. If the tuning range is too narrow, the source will not be able to track the noise and the loop will fall out of lock. Because any measurements made under this condition are invalid, the 3047A detects this condition and halts the measurement. If the tuning range of the controlled source is too large, the source will be extremely sensitive to noise on the control line and this will increase the effective noise of the reference oscillator.

For instance, if we wish to use a fundamental crystal oscillator as the reference source, it will not be possible to measure LC oscillators with the system. The crystal oscillator has a tuning range of a few tenths of Hertz, whereas the LC oscillator will drift well out of this tuning range.

Noise Sideband Mode

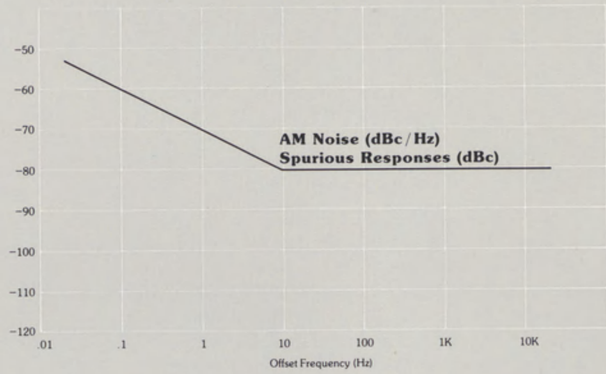
Frequency

Carrier Frequency Range: 20 Hz to 40.095 MHz
Offset Frequency Range:

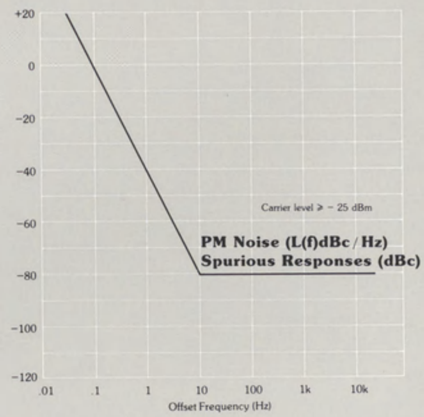
Carrier Freq.	Offset Freq.
95 kHz to 40 MHz	0.02 Hz to 25 kHz
9.5 kHz to 95 kHz	0.02 Hz to 1 kHz
950 Hz to 9.5 kHz	0.02 Hz to 100 Hz
95 Hz to 950 Hz	0.02 Hz to 10 Hz
20 Hz to 95 Hz	0.02 Hz to 1 Hz

Carrier Signal Level: + 30 dBm to — 60 dBm
Input Impedance: 50Ω
Phase and Amplitude Accuracy:
From 0.02 Hz to ½ maximum offset frequency: ± 1.5 dB
From ½ maximum to maximum offset frequency: ± 3 dB

AM Analysis



PM Analysis



Measurement Restrictions

Tracking Range: ± 150 Hz (The system is capable of tracking up to 150 Hz of carrier drift during the measurements
Amplitude variations must be less than ± .5 dB during measurements

Direct Spectrum Measurement Mode

Frequency

Center Frequency Range: 20 kHz to 40.095 MHz
Frequency Span: 5 Hz to 10 kHz
Center Frequency Accuracy: ± (.1ppm/month + 0.1 Hz)
Center Frequency Resolution: 1 Hz
Filter Passband Shape:

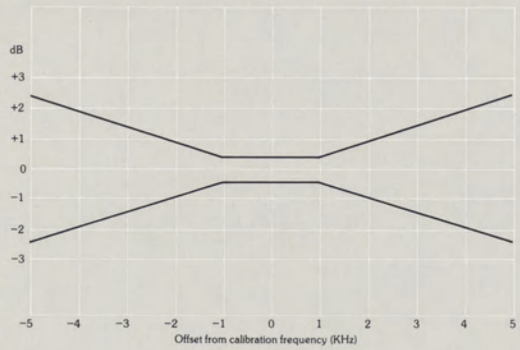
	Flat Top	Hanning	Uniform
3 dB bandwidth	(1.4 ± 0.1)% of Span	(0.58 ± 0.05)% of Span	(0.35 ± 0.02)% of Span
Shape Factor $\frac{\text{60 dB bandwidth}}{\text{3 dB bandwidth}}$	2.6 ± 0.1	9.1 ± 0.2	716 ± 20

Frequency Span	Time Record Length (NΔt)	Calculated Point Spacing (Δf)
5 Hz	50 sec.	.02 Hz
10 Hz	25 sec.	.04 Hz
25 Hz	10 sec.	.1 Hz
50 Hz	5 sec.	.2 Hz
100 Hz	2.5 sec.	.4 Hz
250 Hz	1 sec.	1 Hz
500 Hz	500 msec.	2 Hz
1 kHz	250 msec.	4 Hz
2.5 kHz	100 msec.	10 Hz
5 kHz	50 msec.	20 Hz
10 kHz	25 msec.	40 Hz

The **Flat Top Passband Shape** provides optimum amplitude accuracy. The **Uniform Passband Shape** is optimized for use with transients and the **Hanning Passband Shape** provides an amplitude/frequency resolution compromise and is used for general noise measurements.

Amplitude

Measurement Range: + 30 dBm to — 130 dBm noise floor
Input Impedance: 50Ω
Display Modes: 10 dB/division or 2 dB/division
Dynamic Range: > 70 dB (except 3rd order intermodulation distortion, < − 40 dB)
Amplitude Accuracy: ± 0.9 dB at reference level and center frequency
Filter Accuracy:
Flat Top Filter: + 0, − 0.1 dB
Hanning Filter: + 0, − 1.5 dB
Uniform Filter: + 0, − 4.0 dB
Frequency Response:



Amplitude Linearity: ± 0.2 dB ± 0.02% of full scale.

Overall accuracy is the sum of the accuracy at the reference level and center frequency, the filter accuracy, frequency response and amplitude linearity.

Resolution: ± 0.1 dB with the marker

Marker

Resolution: .4% of span, 0.1 dB
Marker Units: dBm, dBV, relative or absolute amplitude and frequency, RMS noise density (in 1 Hz BW)
Average Modes:
RMS: for each calculated frequency point the displayed amplitude is

$$\sqrt{\frac{1}{N} \Sigma A_i^2(f)} \text{ and the phase is } \frac{1}{N} \Sigma \phi_i(f)$$

Peak: For each calculated frequency point the displayed amplitude is MAX $A_i(f)$ and the phase is the corresponding value for the retained amplitude point.

Number of Averages: 4 to 256 in a binary sequence plus exponential. Exponential in the RMS mode gives a running average with new spectral data weighted ¼ and the previous result by ¾. Exponential in the peak mode gives a continuous peak hold operation.

General Information

Size: The system instruments are mounted in a 142 cm (56 inch) rack. Outside dimensions approximately
163 x 76 x 70 cm
(64 x 30 x 27) inches
The Desktop Computer sits separate from the instrument rack. Outside dimensions approximately
45 x 66 x 43 cm
(18 x 26 x 17) inches

Weight:

Net	Rack	227 Kg (500 lbs)
	Computer	36 Kg (80 lbs)
Shipping		400 Kg (900 lbs)

Power Requirements: 700 VA
48-66 Hz
100 V, 110 V, 220 V, 240 V
Line Operation Options ±10%

Warm up Time: System will meet full specifications 20 minutes after turn on.

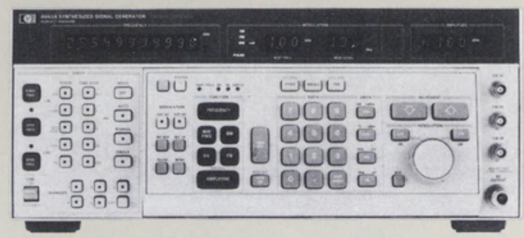
Operating Environment:

Temperature Range: 0°C to 55°C
General Considerations: The 3047A Spectrum Analyzer has been designed to have a low susceptability to RFI and mechanical vibration. However, a great deal of care must be exercised in making measure ments in high RFI or mechanical vibration environ ments as spurious signals may be induced directly in the source-under-test, in the text fixture, or in the system itself. If a problem is suspected, the system can be tested for noise floor and spurious responses using the test fixture and software provided.
EMI: 9836A-based 3047A systems satisfy Level B of VDE specification 0871.

Associated Equipment

For complete information on these products, consult their respective data sheets.

HP 8662A/8663A Synthesized Signal Generators



HP 8663A

The HP 8662A and 8663A Synthesized Signal Generators offer superior spectral purity, frequency resolution and stability over a wide frequency range. Covering 10 kHz to 1280 MHz (to 2560 MHz with the 8663A), they are the ideal reference sources for many phase noise measurements.

Abbreviated Specifications

Frequency Range: 10 kHz to 1280 MHz (8662A) or 100kHz to 2560 MHz (8663A)

Frequency Resolution: 0.1 Hz to 640 MHz; 0.2 Hz to 1280 MHz; 0.4 Hz to 2560 MHz

Output Level Range: – 139.9 to + 13 dBm (8662A) or + 16 dBm (8663A)

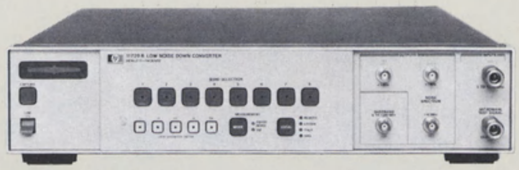
Spectral Purity: (SSB phase noise in 1 Hz BW, 320 < Fc < 640 MHz)

Offset from carrier	10	100	1K	10K	100K	Hz
residual, CW/AM modes	-100	-112	-121	-131	-132	dBc/Hz
typ. absolute	-90	-110	-123	-136	-136	dBc/Hz

(absolute noise includes the phase noise contributed by the synthesizer's internal 10 MHz reference oscillator)

Modulation: complete AM and FM capabilities. External FM input may be DC coupled for phase-locked loop operation.

HP 11729A/B Low Noise Downconverter



HP 11729A/B

The 11729A/B Low Noise Downconverter facilitates phase noise measurements on microwave sources to 18 GHz. A low noise mixing process translates input signals to the band 5-1280 MHz for input to the HP 3047A's quadrature phase detector. In this frequency range, the HP 8662A and 8663A are both suitable reference sources, yielding accurate, sensitive phase noise measurements.

Input frequency range extends to 18 GHz in bands of 1280 or 2560 MHz, depending on residual noise requirements. Model 11729A is the single band version; model 11729B provides multiband operation and complete HP-IB control.

Abbreviated Specifications

Test Signal Input:

5 MHz to 18 GHz, depending on options chosen.
+6 dBm min to + 18 dBm max.

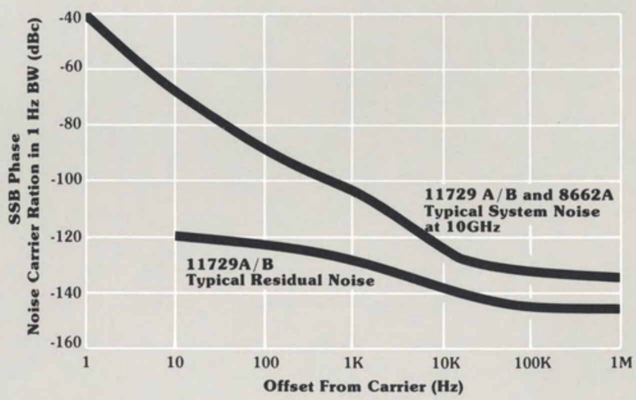
RF Source Input:

Requires HP 8662A or 8663A with options HO3 and H12.

RF Output:

5 MHz to 1280 MHz at + 7dBm minimum

Residual Noise:



Typical 11729A/B residual noise and system noise at 10 GHz.

9872C/T and 7470A Graphics Plotters

The addition of an HP-IB graphics plotter makes it easy to record HP 3047A system measurements for analysis, documentation and presentation. The multi-color report quality graphics are ready for publication when drawn on paper and for group presentations when drawn on overhead transparency film. Recommended plotters include the 8-pen 9872C/T and the 2-pen 7470A.

HP 7470A Graphics Plotter

2671G Graphics Printer

This quiet thermal printer provides hard copies of system-generated text and graphics. With high resolution dot matrix graphics and full alphanumeric capabilities, the 2671G reproduces plots and listings from the 9836A CRT at the touch of a single key.

3047A Spectrum Analyzer System consists of:

HP 3585A 20 Hz - 40 MHz Spectrum Analyzer

HP 3582A .02 Hz - 25 kHz Dynamic Signal Analyzer

Spectrum Analyzer Interface

Rack cabinet 142 cm (56 inches) tall, with all required RF, power and HP-IB cabling, RFI filtering and sliding shelf.

Desktop Computer configured as follows:

9836A Based Systems

HP 9836A Desktop Computer
HP 98601A Option 655 BASIC 2.0 (ROM based)
(2 ea.) HP 98256A 256 Kbyte memory expansion module

9845B Series 100 Based Systems

HP 9845B Option 175 Standard Performance Desktop Computer
HP 98034B HP-IB Interface
HP 98035A Option 001 Real Time Clock

9845B Series 200 Based Systems

HP 9845B Option 275 High Performance Desktop Computer
HP 98034B HP-IB Interface
HP 98035A Option 001 Real Time Clock

Also included:

- system installation and checkout at your site
- operator training at your site
- two complete sets of data cartridges or flexible discs containing all system software
- full set of manuals, including
  - System Installation Manual
  - System Operator's Manual
  - System Reference Manual
  - Controller Manuals
  - Operating and Service Manuals for all instruments

For more information, call your local HP Sales Office or nearest Regional Office: • Eastern (201) 265-5000; • Midwestern (312) 255-9800; • Southern (404) 955-1500; • Western (213) 970-7500; • Canadian (416) 678-9430. Ask the operator for instrument sales. Or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. **In Europe:** Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH 1217 Meyrin 2, Geneva, Switzerland. **In Japan:** Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo 168.

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